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**Геометриялық ойлардың нанотехнологиядағы ролі**

Мақалада нанотехнология математиканы және геометриялық ойларды қолдану арқылы пайда болып, дамып келетіндігі көрсетілген. Осы жорамалдардың дәлелдемесі ретінде нанообъекттердегі электрондардың толқындық қасиеттеріне арналған эксперименттік зерттеулердің нәтижелері қарастырылған. Бұл зерттеулер және олардың нәтижелерінің талдануы геометриялық ойлар нанообъекттерде белгілі формаларды, кеңістіктік қатынастарды құру әдісі ретінде әр түрлі кванттық құрылым және нанообъекттердегі толқындар мен атомдардың визуализациясында басты рөл атқаратындығын көрсетті. Математика, нанотехнология және іргелі физиканың өзара байланыстарының негізінде алынған нәтижелер қоршаған ақиқатты танып-білуге, зерттеу әдістерін кеңейтуге жана мүмкіндіктер ашады.

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**The role of geometric ideas in nanotechnology**

It is shown that nanotechnology is born and develops through the application of mathematics, mainly due to the use of geometric ideas. As proofs of these suppositions the results of a few experimental researches of wave properties of electrons are considered in nanoobjects. These researches and analysis of their results showed that geometrical ideas, as method of construction of definite forms. The spatial relations in nanoobjects has a main role in creation of different quantum structures and in visualization of waves and atoms of nanoobjects. The results obtained based on the relationship (interrelation) of mathematics, nanotechnology, and fundamental physics can open new opportunities in the knowledge of reality and to expand research methods.

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*Ye.A.Buketov Karaganda State University (E-mail: tchlv\_53@mail.ru)***Use of nonconventional lectures in disciplines of the specialty «Radio engineering, electronics and telecommunications»**

In article questions of development of lectures as forms of education in higher education institution are considered. Analysis of didactic and methodical literature is presented in article, the main functions of lecture are formulated. The conclusion is drawn on lectures as about the main forms of the organization of work in higher education institution. Article contains the short characteristic of nonconventional types of lectures. Authors formulated the main requirements to development and carrying out visual lecture. Concrete examples of use of visual lectures are given when carrying out studies «Microelectronics Bases» for the specialty «Radio engineering, electronics and telecommunications».

*Key words:* lecture, visualization, nonconventional forms, active methods of training, didactic principles

Lecture is the main form of the organization of educational process in higher education institution. Lecture is also main link of a didactic cycle of training. It is the most difficult type of work therefore lectures are given by only skilled teachers.

Modern researchers allocate [1, 2] in function lecture: information (lecture contains necessary data), motivational (lecture awakens interest to a subject), organizational and orientation (lecture directs attention being trained on important questions), methodological (lecture gives the analysis of the scientific theory, opens methods of scientific research and the principles of scientific search), both estimated, and developing and bringing up (lecture forms analytical thinking, develops the identity of the student, opens wide his outlook).

Practice shows that teachers not always manage to realize all listed functions of lecture. Therefore there can be a gap between ideal and real function of lecture in higher education institution. In educational process there are situations at which not to replace lecture form of education with other forms of education.

The lecture purpose — formation of approximate knowledge for the subsequent assimilation by students of a training material. Now there is a dispute on value of a lecture form of occupations in educational process. Some scientists [3, 4] consider that lecture brakes independent thinking of students, and that lecture is inefficient form of education of students.

Experience shows that refusal of lectures will lower scientific level of preparation of the being trained. Therefore lecture remains the main form of the organization of educational process in higher education institution. On the contrary the role of lecture increases in modern conditions [1, 2] and requirements to lecture at the same time increase. Today lecture has to be differentiated, multipurpose. Lecture has to carry out information, methodological, estimated functions, it has to develop and bring up students. Therefore value of the organization of study of students at lecture, after lecture increases and by preparation for lecture. The lecturer has to be able to prepare and give lecture and to prepare for it students. Teachers solve today a new problem of formation of study of students. The humanization and development of a modern education system stimulated development of the active methods of training (AMT).

Active training treat: compulsory activity of thinking steady and a long involvement of trainees in educational process, increase of degree of motivation and emotionality of trainees, independent development of decisions, and, at last, interaction of trainees and teacher (realization of straight lines and feedback). Today active training is one of the main directions of pedagogical researches.

New forms belong to AMT, methods and tutorials It is innovative active lectures, seminars discussions, business games, methods of mathematical modeling, academic year and degree projects etc. [1, 2]. Experience of use of active training shows that in comparison with traditional training it helps to solve problems of professional education.

The special place among AMT is taken by innovative types of lectures, such, as problem lectures, visual lectures, «lectures together», lectures of a press conference, lecture dialogues, lecture discussion, etc. [3, 4]. All listed lectures can supplement traditional lecture [1, 2]. Besides, new forms assume development of author's lecture courses.

Let's consider short characteristics of nonconventional forms of carrying out lectures.

Problem lecture begins with questions, statement of a problem which needs to be solved. Such lecture enters new knowledge as unknown for listeners. Therefore received information is acquired as personal opening. It distinguishes problem lecture from traditional lecture.

Visual lecture gives the main contents in the form of images (in drawings, schedules, charts, schemes, etc.). Visualization in this case is way for thinking activity. It also a way of information transfers through change of a code with various sign systems.

«Lecture together» is a work of two teachers who lecture on the same subject and cooperate with each other and with audience.

Lecture a press conference is a lecture which is formed concerning audience, thus lecture can be to give some teachers or being trained.

Lecture with the planned mistakes or lecture provocation is lecture for ability development quickly to analyze professional situations, to play a role of the expert, the opponent.

Lecture dialogue is a direct contact of the teacher with audience. Lecture allows to draw attention of listeners to important questions of a subject, to consider features of trainees.

Lecture discussion assumes a free exchange of opinions at a statement of a training material.

All these types of lectures show transition from classical lecture to modern forms of lectures. It means that lecture it isn't simple information transfer, and process of creative theoretical thinking. Such process increases a role of students in the course of training and increases also value of dialogue with the teacher during reading lecture. It is of great importance for formation of professional qualities of experts. This factor matters for modern Kazakhstan therefore our universities pass to credit technology of training. And at credit technology of training the number of lectures in curricula of educational programs is sharply reduced.

In work of higher education institutions of Kazakhstan when lecturing the traditional information form at which the teacher imparts to students ready knowledge through a monologue is used. But already noncon-

ventional forms of carrying out lecture occupations are even more often used also. Modern educational process demands from graduates of universities existence such quality, as competence and mobility. Students of a technical profile of preparation have pragmatic approach to education. They consider that practical knowledge and abilities are important. Therefore they want to study disciplines which will help them with a profession. Such students don't want to study theoretical disciplines, they consider them uninteresting. Therefore teaching of basic theoretical disciplines demands formation of internal motivation from students. It is necessary to put emphasis on studying of theoretical disciplines. In educational process there can be a contradiction between needs for assimilation of missing knowledge and real opportunities of satisfaction of these requirements. The task of the teacher consists in stimulation and management of activity of students. The success in this process depends on methods of development of discipline. Visual lectures are atypical for our universities. Their use helps to awaken interest to knowledge in students. For success of it like lectures students have to have a personal experiment on work with information.

In visual lectures the traditional didactic principle of presentation is realized in a new way. Results of psychological and pedagogical researches testify that presentation promotes successful perception and storing of a training material and allows to stir up cerebration of the being trained. Because process of studying joins both cerebral hemispheres of the person. Existence of visual information strengthens work of the right hemisphere of a brain which is responsible for figurative and emotional perception of the world. Results of use of bright examples confirm an important role of an image in activity of the person.

Visualization allows information to act in an evident image. In modern science and equipment visualization is one elements of processing of difficult information, for example, when we speak about a spatial structure of objects. The visualization for the explanation of such phenomena, as temperature, electromagnetic fields, etc. is effectively used.

Methods of visualization share on data presentations in one, two or three measurements. Distribution was gained by two-dimensional visualization — the image on the plane, on a sheet of paper or on the screen. At the same time the great value is got by methods volume (3D) — visualization. The main methods of visualization treat: drawings, schedules, charts, photos, cards. Great opportunities to users are given by computer visualization (rendering).

Visual lecture teaches students to transform oral and written information to a visual form. This process forms at them professional thinking, teaches students of systematization. «Image» can form for students a basis for cogitative and practical actions. As a result preconditions for development of professional qualities at students are created: they can structure information, work with information in the form of schedules, schemes, tables.

Visual lecture helps to create problem situations and to include vigorous cogitative activity of students. They learn to carry out the analysis, synthesis, generalization, and folding or information expansion. The teacher has to use such forms of education which supplement verbal information. The more in information, the cogitative activity of students is higher than problems.

In visual lecture the didactic principle of availability is realized. Such lectures help to integrate visual and verbal perception of information. The main difficulty of perception of a training material is connected with assimilation of abstract concepts, the phenomena, and processes. Visualization helps to overcome this difficulty and gives to abstract concepts evident character.

Visual lectures have features. The content of such lecture is oral information which is transformed to a visual form. Therefore the teacher has to create, pick up, and make demonstration materials, for addition of oral information.

Preparation of such lecture demands reconstruction, and information code conversion in a visual form with use of technical means of training. The teacher has to give comments of materials of lecture and provide systematic of knowledge.

In lecture visualization an important role is played by logic, a rhythm and giving of a training material, and also skill and style of communication of the teacher with students. In modern pedagogical and methodical literature of [1, 2] lectures visualization recommend to use at the beginning of studying of disciplines.

Lectures visualization is widely used by authors of article in their pedagogical activity. All lecture classes in disciplines of the specialty «Radio Engineering, Electronics and Telecommunications» — a basis of

quantum electronics, a microelectronics basis, optoelectronics teachers read in the visualized form in the Kazakh and Russian languages.

Teachers read all listed disciplines on 3 and 4 courses and therefore the task of teachers is facilitated: students on 3 and 4 courses are able to conduct records of lectures and well perceive a training material. Thus lecturers use special methodical receptions for relief of perception of training material students. So, in the course of lecturing teachers recommend educational and methodical literature, scientific monographs and articles; use interesting examples; give laboratory and practical classes. Besides, teachers use different opportunities for demonstration of communication of a training material with practice.

The form of lectures imitates professional situations in which students need to estimate a large number of information.

The technique of reading such lectures demands preliminary preparation of visual materials according to the content of lecture. Authors of article in the work use the slides issued in Power Point, different types of chips, printing posters, etc.). In preparation of materials participate both teachers, and students and it helps students to create information. For this purpose to students before lecture tasks on preparation of evident materials on lecture are given.

It is possible to give fragments of some lectures on discipline as an example of «A microelectronics basis», the specialty «Radio Engineering, Electronics and Telecommunications» entering into the working curriculum.

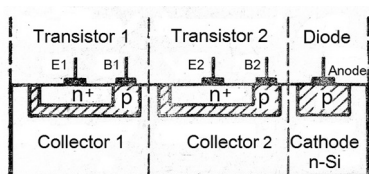
The discipline of «A microelectronics basis» in its classical understanding, consists of three equivalent sections: physical, technological and circuitry bases [5–7].

The subject «Elements of Integrated Schemes» belongs to the section of technological bases of microelectronics. In lecture on the specified subject questions are considered: Isolation of elements (isolation by dielectric; isolation of back displaced p-n-of transition; the combined ways of isolation); N-p-n Transistors (configuration and working parameters; parasitic parameters); Versions of n-p-n-of transistors (many emitter transistor; the transistor with Schottky's barrier; super beta transistor); P-n-p Transistors.

In lecture graphic visualization (the slides executed in Power Point) is used.

Stages of a production cycle of creation of elements of integrated schemes difficult for understanding and perception of students also demand high level of abstract thinking. In lecture these processes are divided into stages, illustrated by schemes and drawings, and it helps students to understand them. So, at an explanation of the reasons of existence of internal communication between elements of the bipolar integrated schemes (IS) the scheme is provided.

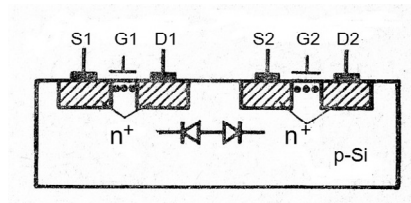
*Internal communication of elements of bipolar IS for lack of isolation*



Transistors 1 and 2 and the diode are executed in the general silicon substrate. Collectors of transistors and the cathode of the diode are connected

At an explanation of one of important advantages of MDP (metal-dielectric-semiconductor) — transistor IS in comparison with bipolar, consisting that in MDP — transistor IS isolation of elements isn't required and therefore MDP — transistors it is possible to have close from each other, the scheme on which lack of communication between elements MDP-transistors of IS shown is provided:

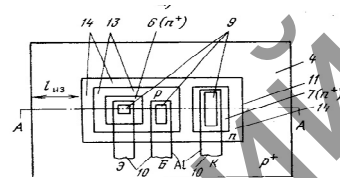
*Lack of communication between elements IS  
MDP-transistors*



Sources and drains of adjacent transistors are divided by opposite included p - n - transitions. Therefore galvanic communication between elements is caused by small return currents of transitions

Further the structure of the epitaxial and planar transistor in different projections (the top view, side-ways) is considered:

*Structure of the epitaxial and planar transistor  
(top view)*



4 — Isolating area of p-type; 6 — Emitter area; 7 — Collector area; 10 — Contact openings; 11 — Lateral surfaces of p - n-transition; 13, 14 — passive areas of base and the collector, not taken with contacts; L — Width of isolating area

According to the plan of lecture transistors with dielectric isolation are considered; ways of isolation by dielectric (epic — process, the SS (silicon on sapphire) technology, the SI (silicon on an insulator) technology. In detail the sequence of the main technological operations used in isoplanar technology and a standard production cycle of creation of integrated n-p-n-of the transistor with the hidden layer by a method of dividing diffusion reveals. Further the lecturer passes to many emitter transistors (MET) and emphasizes features of MET as uniform structure.

All listed questions are difficult and can't be presented by means of natural experiments. Therefore use of receptions of visualization will help students to understand processes, their stage-by-stage realization and value in microelectronic technology.

The analysis of use of visual lecture allows drawing the following conclusions. Such lectures create peculiar "basis" for thinking, develop skills of evident modeling. It helps to increase the intellectual and professional potential of students.

The choice of ways of achievement of the purposes set in lecture and types of presentation depends on a subject. At a statement of big lectures on volume it is expedient to use a combination of different types of presentation. For example, schemes are universal, but means of presentation rather difficult for perception. Therefore as a basis for their designing it is necessary to use drawings because drawings help students to remember and comprehend information well.

Experience of authors proved that the main complexity in preparation of visual lectures consists in a choice of means of presentation, their creation and direction of all lecture. Big role the graphic design, color, an optimum combination of words and visual information, technical means and traditional evident materials here carry out, skill and style of communication of the lecturer with audience.

Besides, application of lectures of this type has to consider psycho physiological opportunities of students.

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### **«Радиотехника, электроника және телекоммуникациялар» оқу бағдарламасының пәндерінде дәстүрлі емес дәрістерді қолдану**

Жоғары оқу орындарында дәріс сабағын дамыту мәселесі қарастырылған. Дидактикалық әдістемелік әдебиеттерді талдау арқылы жоғары оқу орындарындағы оқу үдерісінің негізгі түрі болып табылатын дәріс сабағының негізгі міндеттері талданған. Дәстүрлі емес дәріс түрлеріне қысқаша сипаттама берілген. Дәрісті көрнекі етудің негізгі талаптары келтірілген. «Радиотехника, электроника және телекоммуникациялар» мамандығы бойынша оқылатын «Микроэлектроника негіздері» пәнінің дәріс сабағын көрнекілеудің нақты мысалы берілген.

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### **Использование нетрадиционных лекций в дисциплинах образовательной программы «Радиотехника, электроника и телекоммуникации»**

Рассмотрены вопросы развития лекционной формы обучения в вузе. На основе анализа дидактической и методической литературы сформулированы основные функции лекции, как основной организационной формы, используемой в вузе. Даны краткие характеристики нетрадиционных видов лекций. Сформулированы основные требования к разработке и проведению лекции-визуализации. Приведены конкретные примеры использования лекций-визуализаций при чтении дисциплины «Основы микроэлектроники» для специальности «Радиотехника, электроника и телекоммуникации».

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